PROTECTED AREAS ON VANCOUVER ISLAND:

AN ANALYSIS OF GAPS IN REPRESENTATION FOR CONSERVATION PURPOSES

August 13, 1992

Marvin Eng, RPBio.
Research Ecologist
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1991/1992 Progress Report; EP 1145

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SUMMARY

This report discusses protected areas on Vancouver Island from the point of view of conservation goals, not recreation/culture goals. It focuses on an assessment of gaps in representation of ecosystems by protected areas, not an assessment of protection of rare natural elements.

Assessing gaps in representation of the protected areas system requires:

1) a map that depicts the range of ecosystem diversity;
2) a map that depicts the degree of human modification;
3) a map of the existing protected area system; and
4) an objective for the amount of land to be protected.

I used ecological land classifications, land cover mapping and parks mapping for 1, 2 and 3, respectively. As an objective, I used representation of 12% of each component of the ecological land classification, in an unmodified state (not harvested or urban).

Vancouver Island's ecosystems are diverse, with wet lowlands in the north, wet and dry mountains in the center and dry lowlands in the south. Almost half the island (47%) has been modified by forest harvesting and urbanization. Nine percent (9%) of the island is in protected areas. Most of this (92%) is in four parks: Strathcona, Cape Scott, Brooks Peninsula and Pacific Rim.

The protected area system represents the ecosystem diversity unevenly. High elevation and very wet ecosystems are well represented. Mid-elevation and drier ecosystems are poorly represented.

Based on the goal of protecting 12% of each component of the ecological land classification, an absolute minimum of 207 400 hectares needs to be added to existing the 287 600 hectares in protected areas. This would put a minimum of 15% of the island in protected areas. This is greater than the 12% goal because the existing protected areas include 121 200 hectares of high elevation and wet ecosystems, immature forest urban areas that are not required to meet the 12% goal.

This analysis provides a basis for evaluating the existing protected area. However, it has several limitations for developing a protected area strategy. Attempts are being made to overcome these limitations.

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1 CONTEXT AND OBJECTIVES

On May 6, 1992 the Government of the Province of British Columbia announced that it intended to develop "one of the most comprehensive and systematic plans for protected areas in North America" (Anon. 1992). The Protected Areas Strategy (P.A.S.) is intended to complement the work of the Commission on Resources and the Environment (C.O.R.E.).

In April of 1991, while with the Ministry of Environment, Lands and Parks, I initiated a research project which had as one of its objectives the collection and analysis of information that would "facilitate the development of a comprehensive conservation system plan for Vancouver Island" (Eng 1991). This project anticipated the needs of the P.A.S. and C.O.R.E. for information on Vancouver Island and was largely completed when the two initiatives were announced.

The Protected Areas Strategy is intended to meet the goals of protection for conservation, recreation and cultural/heritage purposes. In this report protected areas will be discussed only from the point of view of conservation goals; not from the point of view of recreation or cultural/heritage goals.

I believe that protected area system, for conservation purposes, should contribute maintaining ecological processes within the context of integrated resource management. The goals of a protected area system should be to:

1) represent the full range of ecosystem diversity; and

2) protect rare natural elements.

Ideally these goals would be met first by protecting areas that represent the range of ecosystem diversity. Those areas would then be examined to determine which rare elements they contained. Additional areas would be protected to include those elements that had been missed. However, the process is somewhat constrained by the existing protected area system. Therefore, the level of representation in the existing protected areas system must first be evaluated of and then areas can be chosen to fill the gaps in representation.

This progress report is largely concerned with an assessment of the gaps in the representation of the existing protected areas system on Vancouver Island. I conclude with a discussion of work in progress that is designed to assist in selecting areas to fill those gaps.

2 DATA SOURCES AND METHODS

Assessing gaps in representation of the existing protected areas system requires, at a minimum:

1) a map that depicts the range of ecosystem diversity;
2) a map that depicts the degree to which humans have modified the ecosystem diversity;
3) a map of the existing protected area system; and
4) an objective for the amount of ecosystem diversity to be protected.

Ecosystem diversity

Ecosystem diversity includes all the organisms, communities and processes that occur, many of which have not even been identified. The best approximation of ecosystem diversity, for my purposes, are systems of ecological land classification. In British Columbia there are two complementary systems of ecological land classification. The ecoregion classification system (Demarchi et al. 1990) is based on climatic processes and physical geography. The system has seven hierarchical levels ranging from ecodomains, based on broad climatic differences, to ecosections based on minor differences in physical geography and on climatic subregions. The Biogeoclimatic Ecosystem Classification (BEC) (Meidinger and Pojar 1991) is a hierarchical system that uses climate, soil and vegetation to group ecosystems. At a regional level, BEC zones are based on broad differences in climate and dominant plant communities. At a more local level BEC subzones and variants are based on finer climatic differences and resultant differences in plant communities.

In general, at a regional scale of mapping (1:250 000), Hopwood (1992) indicates that BEC subzones within ecosections can adequately describe ecosystem diversity for conservation area planning. For coastal British Columbia, at least, I believe that BEC variants, rather than subzones, must be used because many variants tend to have an elevational component to their description. Other information would be desirable but mapping of this information is not available (see 5. Limitations of the Analysis).

I obtained ecosection mapping from BC Environment, Wildlife Branch. I obtained BEC Subzone/Variant mapping from the Ministry of Forests, Vancouver Region.

Human Modification of Ecosystem Diversity

The degree to which humans have influenced ecosystem diversity has been approximated for Vancouver Island through visual interpretation of satellite imagery by the Ministry of Forests, Inventory Branch. The resulting "land cover" map depicts urban areas and immature (harvested) forest area, which have been heavily

modified, and "natural areas" (bogs and alpine) and mature (unharvested) forest, which have been largely unmodified.

3 Existing Protected Areas System

I obtained a map of existing protected areas from a map of land tenure compiled by BC Environment, Region 1, Habitat Protection Section. The boundaries of all the protected areas greater than 250 ha in size were checked, and corrected if necessary, using paper maps of individual protected area provided by BC Parks, Planning and Conservation Services Branch.

4 Objectives for Amounts Required

The question of "how much is enough?" has always been one of the most difficult to answer in the fields related to natural resource management. In the context of conservation biology the question of "how much is enough?" has received surprisingly little attention. Numerous papers address the question of the appropriate size for individual reserves (e.g. Newmark 1987, Simberloff 1989) but, to my knowledge, there has been no rigorous evaluation of what proportion of the land should be protected to provide adequate representation. In fact this question really only has one answer: no area is too small to provide some representation; more area will be always better and; only 100% is enough to completely represent ecosystem diversity because every place on the earth's surface is different.

However, when trade-offs between competing viewpoints must be considered, then estimates of optimum quantities and minimum acceptable quantities are required. In general, the conservation biology community has come to rely on the estimate of Bruntland (1987) that an absolute minimum of 12% of the earth's land surface should be placed in protected areas. The "12%" goal has also been stated several times by the Government of the Province (Anon. 1992).

I believe that 12% represents a reasonable minimum acceptable goal and a good point from which to begin an evaluation of the existing protected area system. The 12% goal should not be rigidly adhered to when developing a comprehensive protected areas system.

Data Compilation and Summary

Maps of ecosystem diversity, human modification and the existing protected area system (as outlined above) were obtained in a digital (computerized) form. These maps were placed on a common digital topographic base (Federal 1:250 000 NTS NAD27) using a geographic information system (Pamap GIS). The map layers were overlaid and summaries of area by category were produced for individual layers and for appropriate combinations of layers.

3 RESULTS

Ecosystem diversity

Vancouver Island is divided into five ecosections which are grouped into two ecoregions (Table 1, Figure 1). The **Western Vancouver Island Ecoregion** includes 3 ecosections:

* The **Northern Island Mountains Ecosection** is a partial rainshadow area of wide valleys and mountains.
* The **Nahwitti Lowland Ecosection** is an area of low to rolling topography, with high precipitation.
* The **Windward Island Mountains Ecosection** is the area of lowlands, islands, and mountains with high precipitation.

The **Eastern Vancouver Island Ecoregion** is an area of reduced rainfall leeward of the Vancouver Island Ranges. It includes two ecosections:

* The **Leeward Island Mountains Ecosection** is a mountainous area from the crest of the island ranges to the Nanaimo Lowlands.
* The **Nanaimo Lowland Ecosection** is a coastal plain with a mild climate situated on the southeast margin of Vancouver Island.

On Vancouver Island there are four Biogeoclimatic zones which are divided into eleven subzone/variant combinations (Table 2, Figure 1). The **Coastal Douglas-fir zone** is limited to a southeastern Vancouver Island. This zone lies in the rainshadow of the Vancouver Island and Olympic Mountains. It is has warm, dry summers and mild wet winters. The Coastal Douglas-fir moist maritime subzone is the only identified subzone. This subzone has no variants.

The **Coastal Western Hemlock zone** occurs at low to middle elevations. This is the rainiest biogeoclimatic zone in the province. Summers are typically cool (although hot dry spells can occur) and winters are mild. Five subzones have been identified on Vancouver Island on the basis of continentality (hypermaritime and maritime) and precipitation (very dry, moist and very wet). Subzone/variants provide a more specific delineation of moisture regime on the basis of relative location (eastern, western, submontane, montane, and outer variants). Western variants are wetter than eastern variants. Montane variants are colder and wetter than submontane variants.

The **Mountain Hemlock zone** occupies the subalpine elevations . Summers are short and cool and winters are long, cool, and wet with deep snow for several months. One subzone, with two variants occurs on Vancouver Island; the moist maritime subzone with windward and windward/parkland variants.

The **Alpine Tundra zone** occurs above the Mountain Hemlock zone. The harsh alpine climate is cold, windy, and snowy, and characterized by low growing season temperatures and a very short frost-free period. No subzones or variants have been identified.

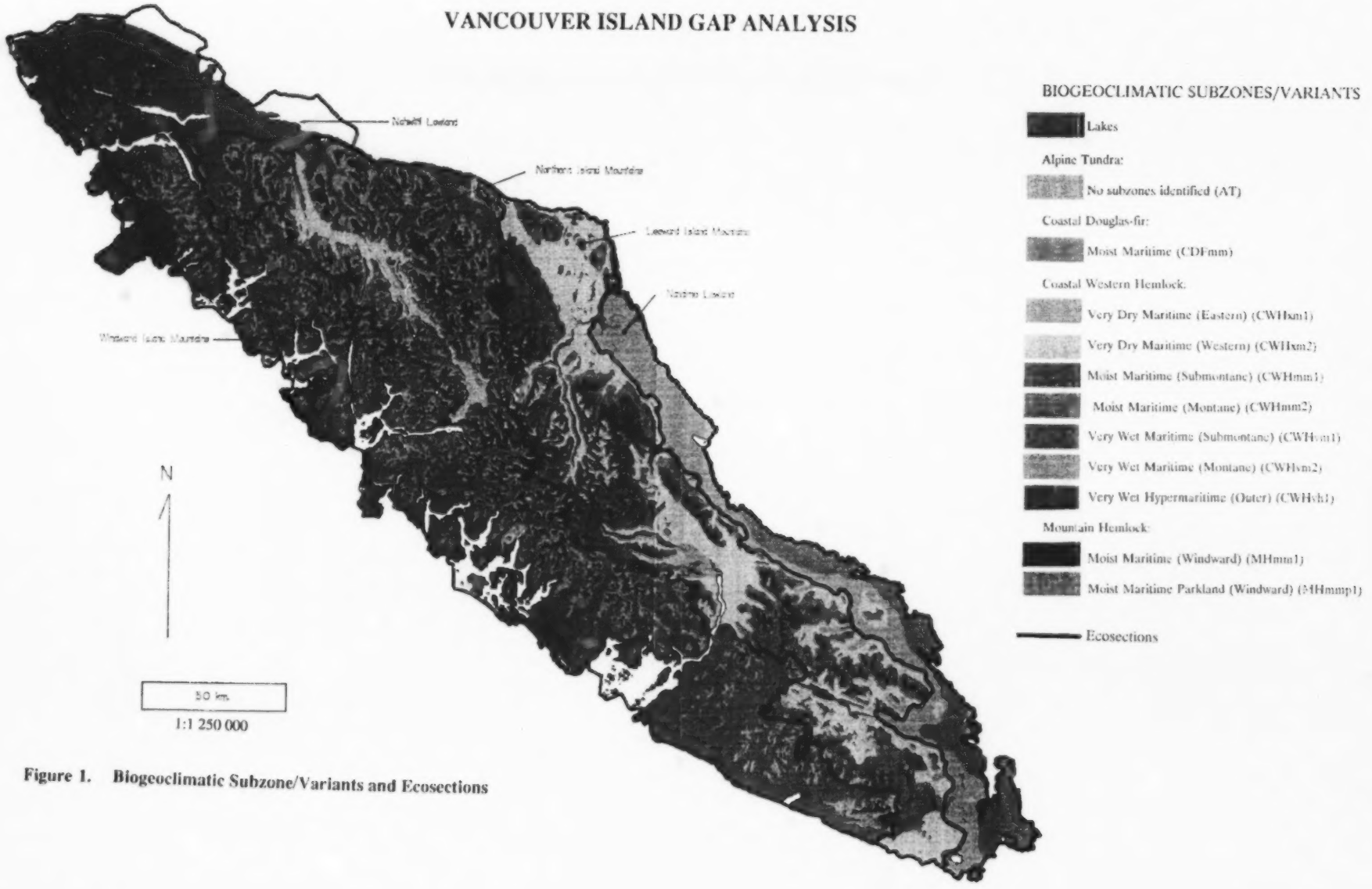

Figure 1. Biogeoclimatic Subzone/Variants and Ecosections

Table 1. Area of ecoregions and ecosections on Vancouver Island.

Ecoregion Ecosection	Area (hectares)
Western Vancouver Island	1 988 400
Northern Island Mountains	581 100
Nahwitti Lowlands	250 400
Windward Island Mountains	1 156 900
Eastern Vancouver Island	1 283 200
Leeward Island Mountains	935 100
Nanaimo Lowlands	348 100
Total	3 271 600

Table 2. Area of Biogeoclimatic zones and subzone/variants on Vancouver Island.

Zone Subzone/Variant	Area (hectares)
Coastal Douglas-fir	
Moist Maritime (CDFmm)	123 600
Coastal Western Hemlock	2 669 500
Very Dry Maritime (Eastern) (CWHxm1)	225 200
Very Dry Maritime (Western) (CWHxm2)	412 000
Moist Maritime (Submontane) (CWHmm1)	140 800
Moist Maritime (Montane) (CWHmm2)	226 400
Very Wet Maritime (Submontane) (CWHvm1)	965 500
Very Wet Maritime (Montane) (CWHvm2)	384 400
Very Wet Hypermaritime (CWHvh1)	315 200
Mountain Hemlock	385 700
Moist Maritime (Windward) (MHmm1)	336 000
Moist Maritime Parkland (Windward) (MHmmp1)	49 700
Alpine Tundra (AT)	19 100
(Lakes)	73 700
Total	3 271 600

Human Influence on Ecosystem diversity

Vancouver Island has been heavily influenced by human activity compared to more remote areas of the province (Figure 2). Forty three percent of the island has undergone timber harvesting. Another 4% is in urbanized areas. The remainder is covered with relatively unmodified mature (unharvested) forest, "natural" areas (alpine and bogs) and fresh water (Figure 2). The human influence has occurred disproportionately among BEC subzone/variants. In general, the drier subzone/variants, on the east side of the island, have been heavily modified. The high elevation subzone/variants and the wetter subzone/variants, on the west side of the island, have been less heavily modified (Figures 3 and 4).

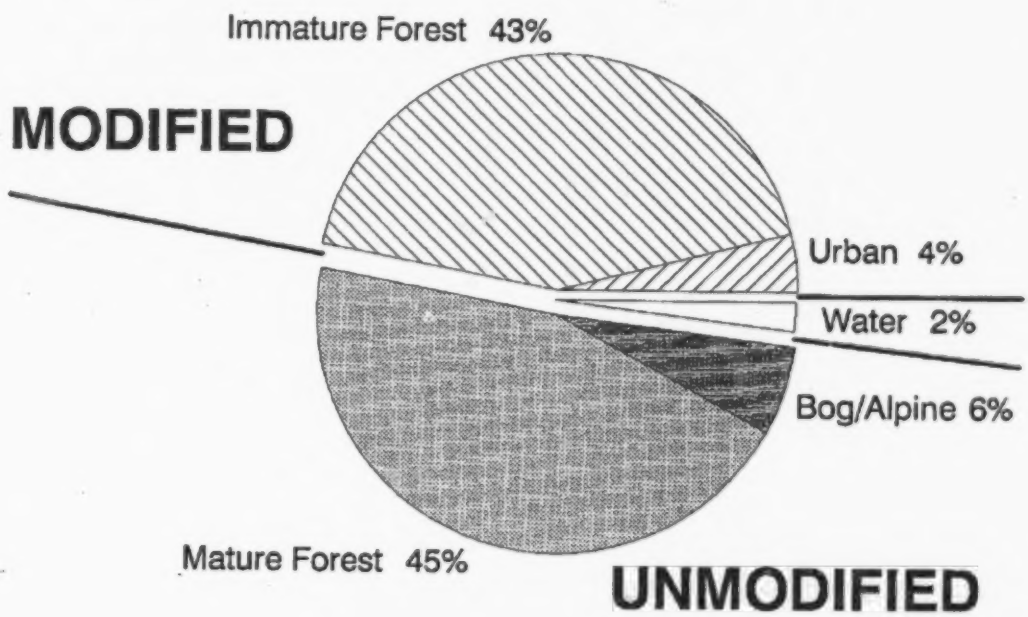

Figure 2. Proportion of Vancouver Island by land cover class

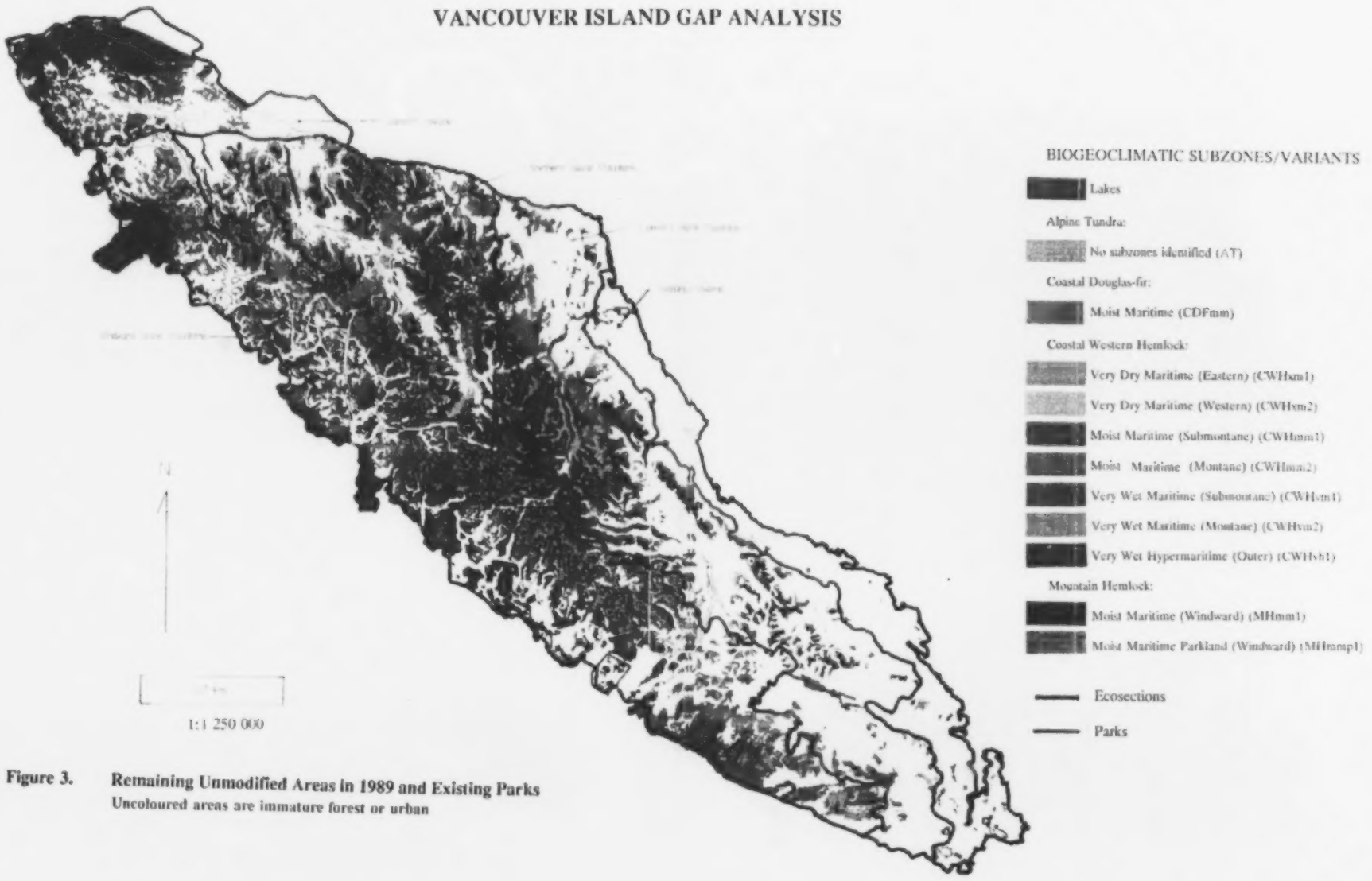

Figure 3. **Remaining Unmodified Areas in 1989 and Existing Parks**
Uncoloured areas are immature forest or urban

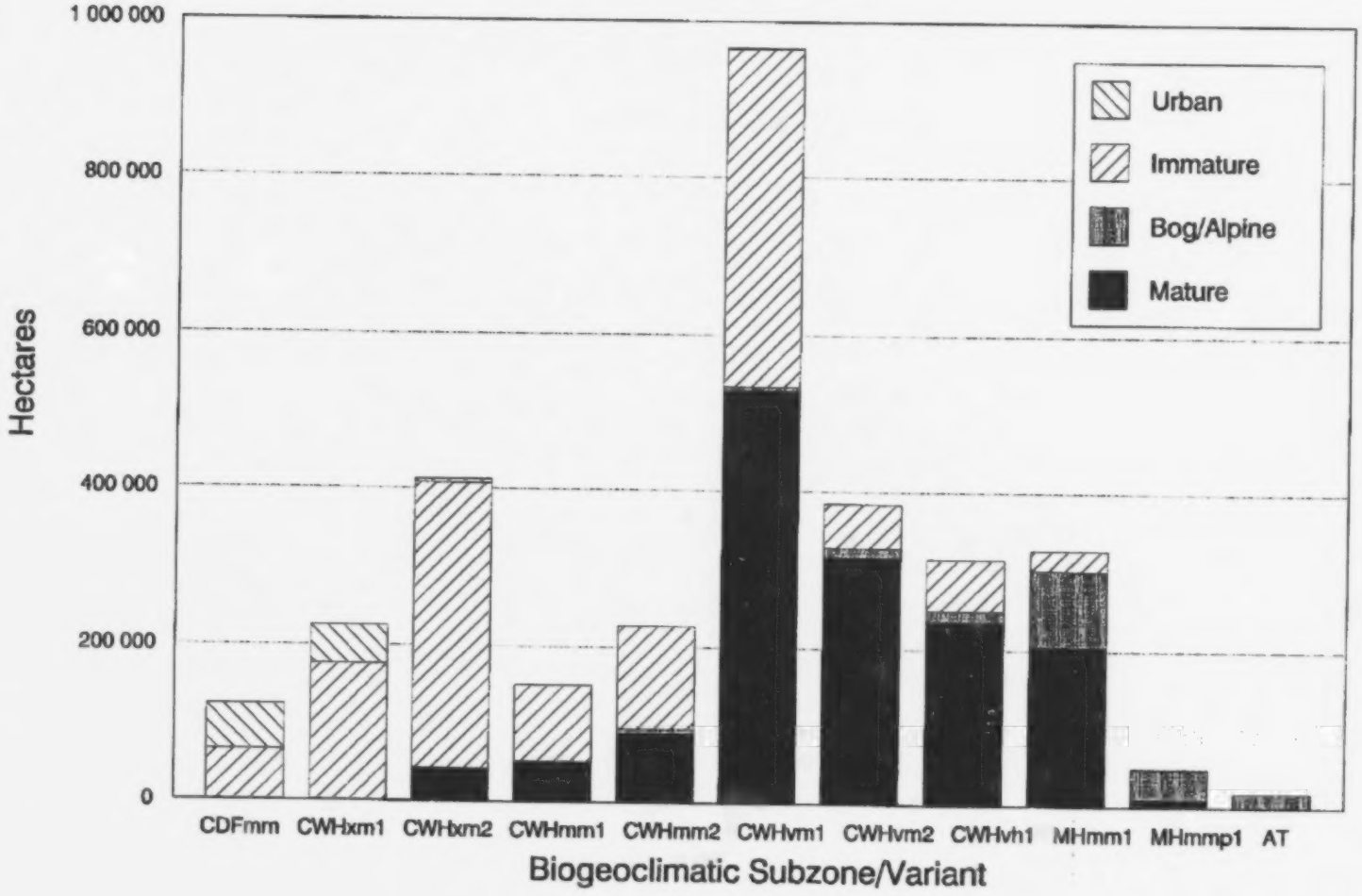

Figure 4. Proportion of Biogeoclimatic subzone/variants in each land cover class on Vancouver Island.

Existing Protected Areas Systems

Approximately nine percent (9%; 287 600 ha) of the land on Vancouver Island occurs in some form of protected area. The remainder of the island is divided among a number of private and Crown owned tenure classes (Figure 5). Of the total protected area, 72.7% occurs in Strathcona Provincial Park. Over 97% of the protected area on Vancouver Island occurs in 5 provincial parks, 1 national park and 5 ecological reserves. Other protected areas, 30 of which have been included in this analysis, are very small (less than 250 ha each) (Table 3).

The existing protected area system has a very uneven representation of BEC subzone/variants (Figure 6). Ninety percent of the Alpine Tundra on Vancouver Island occurs in protected areas whereas less than 1% of the Coastal Douglas-fir moist maritime subzone is protected. Higher elevation subzone/variants are better protected than lower elevation subzone/variants. In general wetter subzone/variants are better protected than drier subzone/variants, although the Coastal Western Hemlock very moist maritime subzone is an exception (Figure 6).

Gaps in the Existing Protected Areas System

Table 4 and Figure 7 summarize the gaps in representation of the existing protected areas system on Vancouver Island by BEC subzone/variant within ecosection. These gaps are based on the assumed goal of representing, in the protected area system, 12% of each subzone/variant in each ecosection, in an unmodified condition. The total gap (additional area required to include 12% of each subzone/variant in each ecosection) is 207 400 ha or 6.5% of the land area on Vancouver Island.

Filling the gaps, by adding the area to the existing protected areas system, would result in at least 15.5% of Vancouver Island being in protected areas. This is greater than the 12% goal because the existing protected area system represents substantially more than 12% of some subzone/variants. These include Alpine Tundra, Mountain Hemlock and Coastal Western Hemlock hypermaritime subzone/variants (Table 4). In addition the existing protected area include 28 600 ha of immature forest or urban areas that do not meet the criteria of being in an unmodified state (Figure 7).

The largest single gap is for the CWHvm1 subzone/variant in the Windward Island Mountains Ecosection (minimum of 52 400 ha required). The largest proportional gap is for all subzone/variants in the Nanaimo Lowlands Ecosection (minimum of 12% of each subzone variant is required). All Ecosections have substantial gaps ranging from 17 900 ha to 65 900 ha. All subzone/variants have gaps except the AT, MHmm1 and MHmmp1. There is also no gap in the CWHmm2 in the Leeward Island Mountains and the CWHvh1 in the Windward Island Mountains.

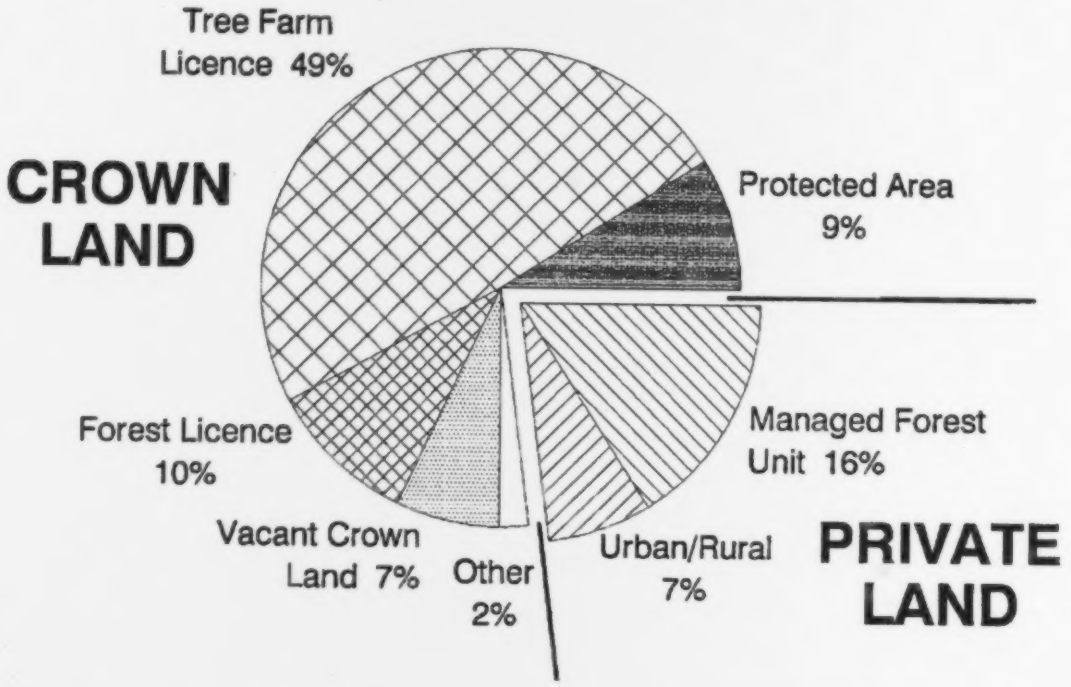

Figure 5. Proportion of Vancouver Island by tenure class.

Table 3. Size of existing protected areas on Vancouver Island.

Protected Area Name	hectares	% of total	Cumulative %
Strathcona Prov. Park	214 800	72.7	72.7
Pacific Rim Natn'l Park	29 700	10.1	82.8
Brooks Peninsula Rec. Area	16 700	5.6	88.4
Cape Scott Prov. Park	11 000	3.7	92.1
Schoen Lake Prov. Park	8 200	2.8	94.9
Carmanah Pacific Prov. Park	3 400	1.2	96.1
Westmim Prov. Park	3 000	1.0	97.0
Five Eco. Reserves >250 ha	1 500	0.5	97.5
Thirty Other Protected Areas	7 200	2.5	100.0
Total	295 600	100.0	
Total in Lakes	8 000		
Total Land in Protected Areas	287 600		

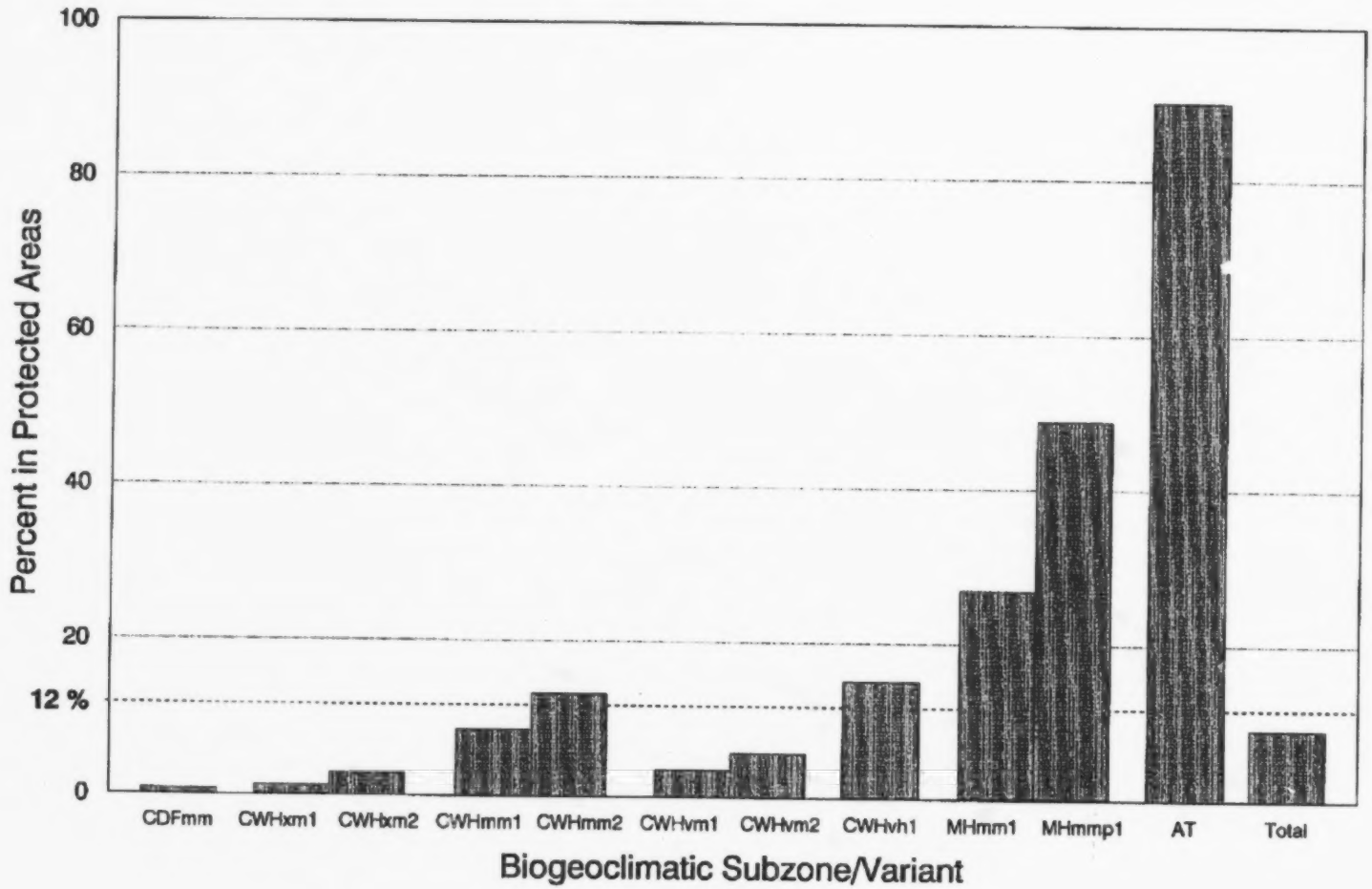

Figure 6. Proportion of Biogeoclimatic subzone/variants in protected areas on Vancover Island.

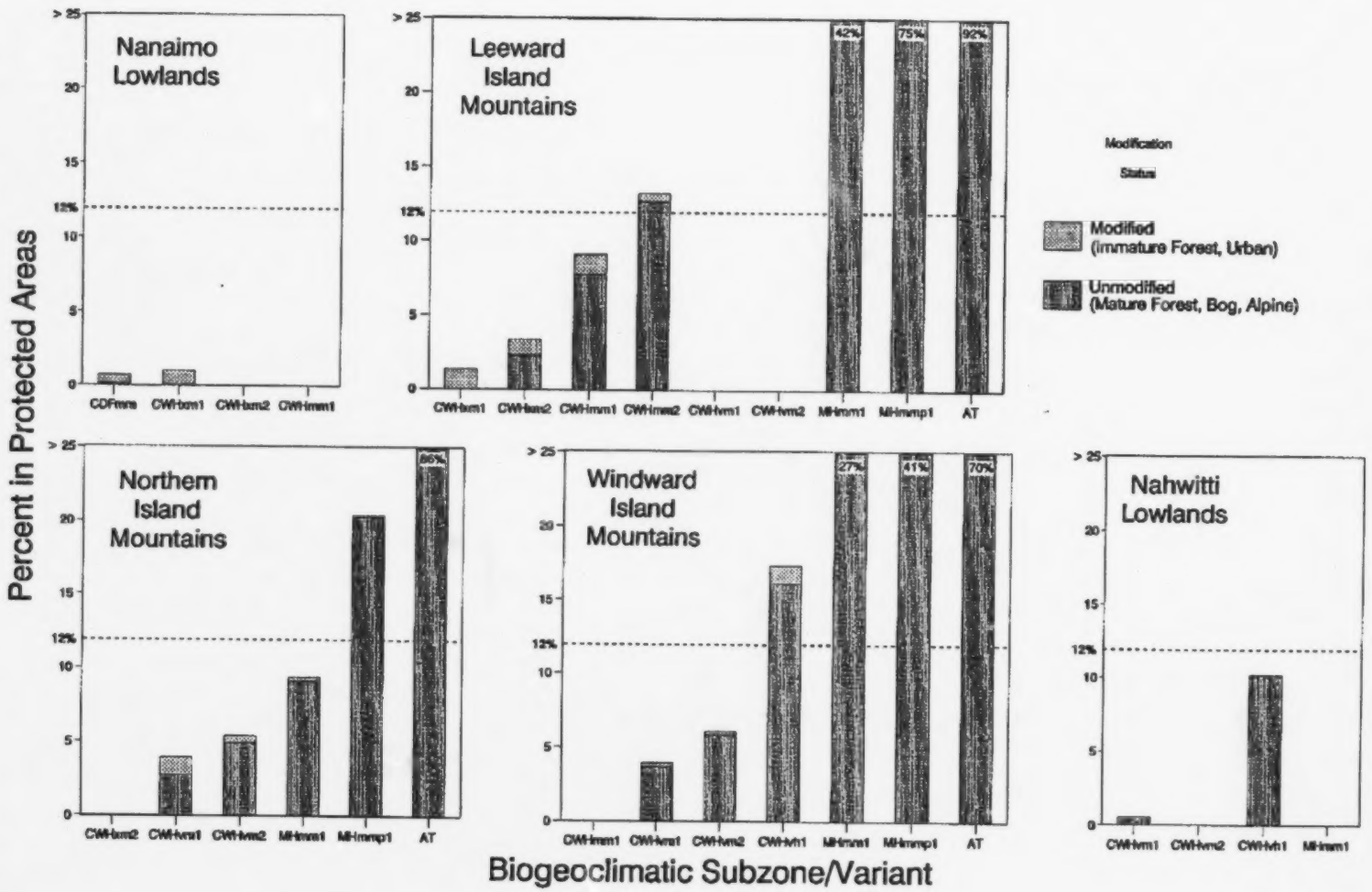

Figure 7. Proportion of Biogeoclimatic subzone/variants in each Ecosection in protected areas on Vancouver Island.

Table 4. Protected areas gap analysis for Vancouver Island.

Ecosection Subzone/Variant	Area (hectares) Total Land	Total Protected	Protected Unmodified	Goal 12%	Gap (Excess)
Nanaimo Lowlands					
CDFmm	123 600	800	100	14 800	14 700
CWHxm1	207 900	2 100	100	24 900	24 900
CWHxm2	8 000	0	0	1 000	1 000
CWHmm1	2 200	0	0	300	300
subtotal	341 700	2 900	200	41 000	40 800
Leeward Island Mountains					
CWHxm1	17 300	200	0	2 100	2 100
CWHxm2	344 700	11 500	8 100	41 400	33 200
CWHmm1	138 700	12 800	10 700	16 600	5 900
CWHmm2	224 200	29 800	28 600	26 900	(1 600)
CWHvm1	5 100	0	0	600	600
CWHvm2	4 500	0	0	500	500
MHmm1	127 800	53 700	52 900	15 300	(37 600)
MHmmp1	23 400	17 700	17 700	2 800	(14 900)
AT	16 100	14 700	14 700	1 900	(12 800)
subtotal	901 800	140 400	132 700	108 200	42 400 (66 900)
Windward Island Mountains					
CWHmm1	2 000	0	0	200	200
CWHvm1	628 600	24 800	23 100	75 400	52 400
CWHvm2	217 100	13 100	12 800	26 100	13 200
CWHvh1	205 100	35 500	33 000	24 600	(8 400)
MHmm1	79 600	21 600	21 500	9 500	(11 900)
MHmmp1	5 100	2 100	2 100	600	(1 500)
AT	700	500	500	100	(400)
subtotal	1 130 400	97 600	93 000	136 600	65 900 (22 300)
Northern Island Mountains					
CWHxm2	59 200	0	0	7 100	7 100
CWHvm1	198 800	7 800	5 400	23 900	18 400
CWHvm2	157 800	8 500	7 700	18 900	11 200
MHmm1	128 400	12 100	11 600	15 400	3 800
MHmmp1	21 200	4 300	4 300	2 500	(1 800)
AT	2 300	2 000	2 000	300	(1 700)
subtotal	567 700	34 700	29 100	67 800	40 500 (3 500)
Nahwitti Lowlands					
CWHvm1	133 000	700	700	16 000	15 300
CWHvm2	5 000	0	0	600	600
CWHvh1	110 100	11 300	11 200	13 200	2 000
MHmm1	200	0	0	0	0
subtotal	248 400	12 000	11 900	29 800	17 900
TOTAL	3 197 900	287 600	267 000	383 400	207 400 (92 600)

4 DISCUSSION

Vancouver Island has a high degree of ecosystem diversity, ranging from very wet lowlands on the north, through wet and dry mountains in the center to very dry lowlands on the south. The existing protected area system represents this ecosystem diversity poorly. High elevation ecosystems and very wet ecosystems are well represented. Mid-elevation ecosystems on the western side of the island and drier ecosystems throughout the island are poorly represented.

The disproportionate representation of the existing protected area system results from the fact that 92.1% of the protected area on Vancouver Island occurs in four protected areas (Table 3). These parks are situated either at high elevations (Strathcona Park) or along the very wet western edge of the island (Pacific Rim National Park, Cape Scott Provincial Park and the Brooks Peninsula Recreation Area). The remaining protected areas are relatively well distributed across the island but they have two major failings in terms of representation of ecosystem diversity. First, and most importantly, they are simply too small to adequately protect the ecosystem diversity of the island. Secondly, many of the parks in the drier ecosystems occur in areas that have been heavily modified by humans (immature forest or urban areas) and may no longer contain the original biological diversity.

In order to meet the goal of representing 12% of each subzone/variant in each ecosection a absolute minimum of 207 400 hectares needs to be added to the existing protected areas system. This area, plus the existing protected areas, would represent 15.5% of the island. This is greater than the 12% goal because the existing protected area system represents substantially more that 12% of some subzone/variants. These areas include high elevation subzone/variants and very wet subzone variants (92 600 ha; Table 4). Also included in the area that is "excess" to the conservation goal are 28 600 hectares of heavily modified land (immature forest and urban areas) that is inside protected areas (Figure 7).

Making up the gaps in the existing protected area system will undoubtedly require more than the absolute minimum of 207 400 hectares. Many of the gaps occur in subzone/variants that are found at specific elevations (lower and mid-slope ecosystems). It would be undesirable to create protected areas that contain only these ecosystems.

Although this analysis is specifically focused on describing gaps in the existing protected area system it also points out several features of a strategy to fill those gaps.

1. In general, additional parks are not required in the Alpine Tundra and Mountain Hemlock BEC zone. This does not preclude placing additional areas in those zones where they are part of "sea shore to mountain top" ecosystems reserves.

2. The largest gap, by area, occurs in the very wet maritime subzone (submontane variant) of the Coastal Western Hemlock zone (CWHvm1). This gap is "pronounced" throughout the three ecosections of the Western Vancouver Island Ecoregion where this subzone/variant occurs. Substantial opportunity for representing this subzone/variant in protected areas exists because over half of it occurs in a relatively unmodified state (Figure 4). Therefore this subzone/variant should be a priority for protected area additions.

3. Most of the largest gaps, as a percentage of a subzone/variant within an ecosection, occur in the Nanaimo Lowlands and Leeward Island Mountains ecosections of the Eastern Vancouver Island Ecoregion. Unfortunately, for the largest of these gaps (the Coastal Douglas-fir zone [CDFmm] and the very dry variant of the Coastal Western Hemlock zone [CWHxm1 and CWHxm2]) very little opportunity exists to obtain protected areas in an unmodified state because of forest harvesting and urbanization (Figure 4). There are still limited opportunities to fill the gap in the CWHxm2 subzone/variant in the Leeward Island Mountains and these opportunities should be pursued. Consideration might also be given to special protective status for what little remains in the other very dry subzone/variants in the Eastern Vancouver Island ecoregion.

4. The existing protected area system protects more than 12% of some subzone/variant in some ecosections. Therefore, if the goal is to be met, either more than 12% of the land area of Vancouver Island must be placed in protected areas or the existing protected area system must be modified to reduce some of the surplus land. Because most of the "excess" land is in high elevation areas, that represent high quality recreational opportunities, the latter option may conflict directly with the recreation goals of the Protected Area Strategy.

5 LIMITATIONS OF THE ANALYSIS

The Provincial Government has embarked on the development of a Provincial Protected Area Strategy. The analysis presented here could be viewed as a prototype for a province wide analysis to support the protected area strategy. Therefore, it is critical that the limitations of the present analysis be highlighted.

A description of ecosystem diversity based on subzone/variants within ecosections is limited in two important respects. First, it will not include many representative features of the natural environment that are not mapped with these systems of ecological land classification. These features include animal species distribution and specific "habitat types" such as fiords, riparian areas, rock outcrops, etc. Secondly, because the two systems were developed somewhat independently the potential exists for classification anomalies when they are combined. That is, there is a potential to give too much importance to a subzone/variant that occurs as a very small area near the border of an ecosection. These areas may not be "worthy" of special consideration because of the approximate and conceptual nature of the boundary lines in both mapping systems.

Describing the degree of human modification of the environment through visual interpretation of satellite imagery is also limited in two important respects. First, this method is fraught with difficulties in terms of classification accuracy and problems of adequately mapping small, dispersed human modifications (e.g. small clearcuts and oil well drilling sites). Secondly, this method can not be used where human modification is less dramatic in its appearance than it is on the coast (e.g. cattle grazing and selective harvesting in the interior of British Columbia) or where large natural disturbances (e.g. fire) are common.

A simple analysis of the total area in the existing protected area system begs the three most important questions in conservation biology:

1. How small can a reserve be and still be effective and what should the distribution of reserve sizes be (one big one or many small ones) (Newmark 1987, Soule and Simberloff 1987);
2. What is the ideal shape and placement of an individual reserve (Blouin and Conner 1985); and
3. How should reserves be distributed across the region to effectively link and connect them in an ecological sense (Noss and Harris 1986)?

These questions must be addressed even though they have no "real" answers.

Finally, this analysis offers little assistance in the development of a strategy to fill gaps in the existing protected area system. This is a multi-faceted problem that basically requires a set of protected area selection criteria. Discussion of the methods of

developing those criteria and methods of overcoming the limitations listed above is beyond the scope of this document. Work on the Vancouver Island gap analysis project is ongoing and attempts are being made to wrestle with these problems both within this project and within the technical committees associated with the provincial Protected Area Strategy. I believe that, despite the technical and conceptual difficulties, an analysis like the one presented here can greatly assist the process of achieving the overall of goal of developing and implementing "one of the most comprehensive and systematic plans for protected areas in North America" (Anon. 1992)

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